

# the reACTant

The Newsletter of the Associated Chemistry Teachers of Texas

## Summer 2005 and beyond

by Dale Moore  
and Jane Smith

The University of North Texas was the venue for the "Silver Edition", where 81 people participated in thirty seven presentations and workshops. Bette Bridges, Andy Cherkas, and Pat Funk kept us in stitches all week and we saw many new demonstrations. On Friday morning almost everyone was involved in the tie-dye lab coat workshop or Dr. Peck's burning book construction. Friday night found us at the Circle R Dude Ranch eating BBQ and roasting Dr. Peck. Kathleen Holley and Trey Seastrunk did a super job detonating a spectacular array of fire works. One individual told me that they had the best time of their life, which made all the work worth the effort.

At the end of July, eight ACT<sub>2</sub> committee members attended the ChemEd 05 Conference in Vancouver, British Columbia. Upon checking in at the university dormitory we were given the penthouse (17<sup>th</sup> floor), which overlooked the bay where we witnessed Spain and China present their entries for the "Festival of Lights" international fireworks competition. We enjoyed the week in Canada but were very glad to board the plane headed home; this was especially true for me after my brief encounter with a Royal Mounted Canadian Policeman (pictures to follow). *dm*

Now it's time to gear up for CAST, assuming that Katrina doesn't wash away our hope for Houston. We have a great Chemistry strand of workshops planned on Friday. Be sure to get your luncheon ticket when you register. Our

speakers will be Mickey Sarquis and Lynne Hogue from Miami University who will present *Beyond the Computer: Visualizing the Old Fashioned Way*. They will share strategies to engage and motivate students of all levels and allow them to internalize the abstract concepts in Chemistry. They have also shared some terrific NCW lessons on page 9!

If you couldn't attend the Biennial and you can't come to CAST - don't despair, I plan to share more pictures and teaching tips through the new mini - reACT<sub>2</sub>ant. I hope to send out an issue a month. You'll get your heads-up by email from Bob Casao and I welcome comments and suggestions. *js*

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And much, much, more!

Turn the page and  
read all about it!!

# President's Corner

## A Summer to Remember

Greeting to everyone! I hope your year has started well. This summer presented many challenges and created many rewards. July was memorable as we hosted our biennial conference at UNT in Denton and then went north to attend the ChemEd 05 Conference in Canada.

One of my most noteworthy memories of the conference stemmed from Rosendo Garcia accidentally leaving his two burning books on the bus which caused a Homeland Security alert. Tuesday morning of the next week I received a message on my answering machine saying "my name is Sergeant Sheehee with the Irving Police Department....we need to talk. Can you come to our station and discuss three incendiary devices found on a tour bus? By the way, there will be another gentleman joining us from the FBI." Ask Rosendo and Rhonda Alexander why their finger prints are now on file with the FBI!

As I reflect over my summer, I must also think about the students we touch every day. Ten years from now they will do well to remember our name or even a fraction of what we taught them. But what will be their comment to someone about their high school chemistry class? Will it be "I had a great teacher or I hated that class?" You are the deciding factor for this comment. Do your best to make 2005 - 2006 a year to remember for your students!



Dale Moore

### Treasurer's Report

8/16/05 by Jane Gray	
Opening Balance	\$6955.16
Income	
Interest	\$1.99
Deposit	\$544.00
Total Income	\$545.99
Expenses	
reACTant	\$889.88
Travel (Hepburn)	\$600.00
CAST	\$600.00
Promotions (Allen)	\$337.73
t-shirts	\$462.25
Conference	\$200.00
Total Expenses	\$3089.86
Total Income - Expenses	\$4411.29
Reserve Fund	\$6478.68
Actinium Fund	\$181.00
Betty Bridges	100.00
Biennial 05	\$309.00

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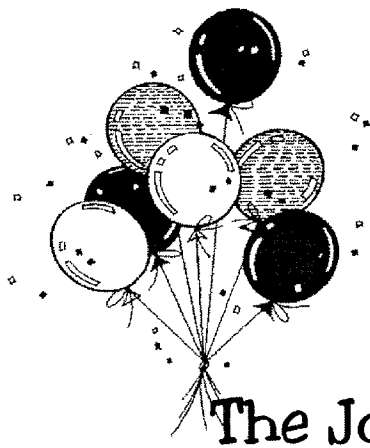
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## The Joy of Toys October 16-22

That's right, this year's National Chemistry Week theme to be celebrated October 16-22 is "The Joy of Toys". What a great excuse to have fun and teach some chemistry at the same time! Think back to some of your favorite toys as a child or perhaps ones you've used with siblings, your own children or grandchildren. Classics like Silly Putty, Play Doh, Magic Crystal Gardens, and Invisible Ink can join the ranks of new favorites like Slime or Gak, Light Sticks, Touchabubbles and Growing Creatures. Find that groovy Lava Lamp and plug it in! What a soothing way to illustrate lessons on density, immiscibility, convection and heat expansion.

Even simple items like a balloon can provide a teachable moment or two.

- ☐ illustrate effusion - put a drop of vanilla extract inside and tie the balloon off
- ☐ illustrate polymer structure - put a bamboo skewer through the balloon
- ☐ illustrate a chemical reaction - blow up the balloon with Alka-Seltzer and water
- ☐ illustrate Charles' Law - expand a balloon on a flask by heating it

<http://www.chemistry.org/new> will take you to the official ACS portal for National Chemistry Week. There you can find some great ideas in the *Celebrating Chemistry* publication. Although geared for elementary grades, many of the activities can be used to spark interest in polymers, gases, surface tension, and chemical reactions and the timeline of historical toys will intrigue adults. The ACS store has items of interest including scratch 'n sniff stickers and Hooray for Chemistry! wrist bands.

The Oregon Museum of Science and Industry's *Experiencing Chemistry* online site has a whole section of activities on the chemistry of toys. <http://www.oms.edu/visit/chemistry> Resources include full experiments on Flubber, Magic Inks and Fireworks and ideas for other take-home activities. The site [http://www.chymist.com/toy\\_store.html](http://www.chymist.com/toy_store.html) can also provide you with recipes for making homemade slime, magic sand, crystal trees and many others.

American Science Surplus <http://www.sciplus.com> has ever-changing stock but items that spin, ooze, glow in the dark and inflate always seem to be available. Can't locate your Lava Lamp? They have a low-tech version - the Goo Tube - that's great for talking about viscosity. Their Touchabubbles come in a test tube container with pocket clip. Kids will have great fun seeing how many bubbles they can stack with these long-lasting bubbles. If you want to purchase magic sand, thermo-sensitive paper, goldenrod (acid-base indicator) paper, liquid bluing for crystal gardens, gro-beasts and UV sensitive beads, a great source is Educational Innovations, Inc. <http://www.teachersource.com>.

So have some **Fluorine Uranium Nitrogen** and celebrate chemistry with toys!



## Celebrate Science Everyday!

The Explorit Science Center in Davis, California provides a nice calendar of science events including a "what happened in science today" feature (<http://www.explorit.org/yearofdays/today.html>).

They also have a calendar ([http://www.explorit.org/science/science\\_days.html](http://www.explorit.org/science/science_days.html)) in which each month features a theme and every day has an associated science fact. For example, August is "orders of magnitude" month. March focuses on Chemistry and the Periodic Table of Elements!

Their science page (<http://www.explorit.org/science.html>) features a variety of fun quizzes and challenges for both students and adults, alike. Who can resist "Coffee, Tea, or Chocolate?" or perhaps a quiz on "water" or one entitled simply, "tasty"?

by Dr. Jim Marshall  
University of  
North Texas

## Tungsten

In 1781 Scheele dissolved a mineral from Sweden called tungsten (now known as *scheelite*) in nitric acid and discovered an acid similar to molybdic acid, which he called *terra ponderosa molybdoenata* (tungstic acid). Two years later the de Elhuyar brothers extracted from wolfram (wolframite) the same acid and prepared a metallic sample by heating with charcoal. The source of the word "Wolfram" is derived from the interference of the ore with the smelting of tin - it supposedly "devoured" the tin.

Tungsten has the highest melting point and the lowest vapor pressure of all metals, and at temperatures above 1650 degrees the highest tensile strength. It is used as filaments in electric lamps and electron and television tubes; for electrical contacts in automobile distributors; and X-ray target and heating elements. Tungsten is used in high-speed tool steels and Hastelloy, and tungsten carbide in metal-working activities.

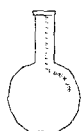
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[Swed. *tung sten*, heavy stone]

Hydrofluoric acid known since 1700s,  
discovered 1781 - isolated 1783

mp 3410 K; bp 5660 K; density 19.3 g/L

Discovery of the Elements, by Dr. Jim Marshall of UNT



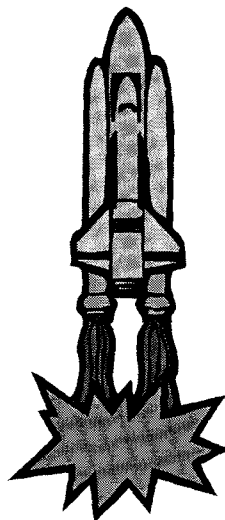
## CAST - Houston

### STAT Annual Conference

October 27 - 29, 2005

Reliant Center

Houston, TX



**Blast Off  
at CAST!!**

Rhonda Alexander  
needs help manning  
the ACT<sub>2</sub> booth.  
Please contact her  
[rhondaa@cox-  
internet.com](mailto:rhondaa@cox-internet.com) if you can  
spare an hour.

More details at  
[www.statweb.org](http://www.statweb.org)

## Change to the BY-LAWS

The ACT<sub>2</sub> Executive Board is proposing a change to the Constitutional BY-LAWS Article III Section 2 regarding the Regional Board of Directors.

The Article currently reads "Each region shall determine its representative and alternate representative." The proposed change will read "The Executive Board will select a representative and alternate representative from each region."

This proposed change will be voted on at the CAST luncheon. The complete BY-LAWS may be viewed at [www.statweb.org/ACT<sub>2</sub>](http://www.statweb.org/ACT2)

ACT<sub>2</sub>

the reACTant, Fall 2005



The National Mole Day  
Foundation wants  
YOU...to Celebrate  
Mole Day!

Although October 23rd  
falls on a Sunday this  
year, that's no reason to  
avoid Avogadro's  
special day

The theme this year is Moles-Go-Round and you can get more ideas by accessing <http://www.moleday.org> as well as some great goodies like mole tattoos and mole cookie cutters. What follows are suggestions gleaned from past year's Mole Day Foundation materials. You can receive this year's materials, including Mike Offutt's 2005 Mole Day song by becoming a member online.

#### Just how big is a mole?

Have your students write their name in chalk (or graphite if you have a 0.0001 g balance) on a piece of paper. Then they can calculate the number of calcium carbonate molecules (or carbon atoms) are present in their signature. If they were a movie star, how many times would they have to sign their autograph to have written a mole of molecules or atoms?



*National Mole Day, October 23, 2005*

#### Two Mole Pledges

Nothing sets the serious tone of an important holiday like a group pledge...

I pledge allegiance to the mole, and to the science from which it comes, one SI unit, extremely divisible, with micromoles and millimoles for all.

*R. Thomas Myers, Kent State University, Ohio*

I pledge allegiance to the mole and to Avogadro's number for which it stands. One mole, of any gas, at STP contains the same number of molecules for all.

*Kathy Austin, Princeton High School, Ohio*

#### Make a mole!

Have your students make a mole and dress it up thematically! Namoleon - Moledanna - Molechael Jackson - Molses - the Three Molesketeers - Several patterns can be found on the ACT<sub>2</sub> website [http://www.statweb.org/act2/mole\\_patterns.htm](http://www.statweb.org/act2/mole_patterns.htm)

#### And of course, the ever-popular Mole Jokes!

What word describes a sad chemist?  
mole-ancholy

What word describe an evil chemist?  
mole-evolent

How would you describe a stinky chemist?  
mole-odorous

*John Hill, University of Wisconsin - River Falls*



*National Mole Day, October 23, 2005*

ACT<sub>2</sub> is sponsoring two rooms of workshops on the Friday of CAST at the convention center. These workshops are given by chemistry teachers, for chemistry teachers and hopefully will provide sessions of interest.

Either Room 305 or 306 will be the site of the ACT<sub>2</sub> Luncheon on Saturday.

### Room 305

**8:30**

Bubbles - An Entry Point to the 5E Model

*Aimee Modic and Jane Gray*

Experience the first 3 E's of the 5E model firsthand as we Engage, Explore, and Explain some fundamental chemical concepts. Take home this adaptable lesson on concentration and expand on a theme!

**10:15**

Create Student Ownership: Use Learning Strategies to Introduce Concepts

*Jane Gray and Aimee Modic*

Participants will experience learning strategies such as jigsaw reading, free-form mapping, and gallery tours, to teach traditionally dry topics in a way that prevents that "glazed over" look.

### Room 306

**8:30**

Removing the Conundrum of Concentration

*Paul Price*

Students have significant difficulties understanding that concentration is an intensive quantity even after working with the units of concentration. This series of classroom activities will allow a student to explore and understand the meaning of concentration in a context familiar to them, the soft drink.

**10:15**

Safety is My Middle Name

*Rosendo Garcia and Roxie Allen*

This session will highlight lab safety requirements. We will look at needed equipment, labels, MSDS, storage, and disposal. Everyone needs a little safety training and this one is better when you bring questions and suggestions. We'll share stories and ideas!

**2:15**

Lowering Student Activation Energy

*Mickey Sarquis and Lynne Hogue*

Reunite the fun, hands-on with the mental, minds-on aspects of chemistry through multi-sensory interactions, visualizations, and modeling. These proven strategies that illustrate abstract chemical concepts and increase both motivation and conceptual understanding in your students will be shared during the workshop.

**4:00**

Enhancing Learning: Microscopic Chemistry with Macroscopic Models

*Claudia Wallace and Jane Smith*

Many chemistry concepts are hard to understand because students cannot visualize what the teacher is teaching since most of chemistry occurs on the molecular level. This session will present models for many chemical molecular concepts enabling students to 'see' what is going on.

# NATIONAL CHEMISTRY WEEK 2005 THE JOY OF TOYS

October 16-22

The Center for Chemistry Education invites scientists, educators, and parents to share the joy of science-based toys with kids of all ages!

**Get 20 FREE activities at**  
**[www.terrificscience.org/nw/](http://www.terrificscience.org/nw/)**

**Brain-Fooling Glasses:** View pictures in another dimension.

**Cartesian Diver:** Dive into learning about density and pressure.

**Diving Toys:** Experience uplifting science when this toy resurfaces.

**Glow-in-the-Dark Vinyl:** Learn how light can create dark images.

**Hand Boilers:** Expand your knowledge about vapor expansion.

**Magic Sand™:** Submerge sand and witness the "magic."

**Self-Inflating Balloons:** Learn how a rise in gas causes inflation.

**Wall Walkers:** Measure speed during a sticky situation.

**and MORE!**

**Plus,**

- Shop for resource books and toys at [www.terrificscience.org/bookstore](http://www.terrificscience.org/bookstore).
- Stop by our Terrific Science booth at the Conference for the Advancement of Science Teaching (CAST), October 27-29, 2005.

National Chemistry Week is a community-based program of the American Chemical Society (ACS). National Chemistry Week's mission is to reach the public, particularly elementary and secondary school children, with positive messages about chemistry.





# CAST Workshops

This year's CAST should be a great one with what seems like a better variety of workshops than we have had for several years.

All workshops are currently scheduled for the Reliant Convention Center. Although, with hurricane refugees filling the Astrodome and other Houston landmarks, that may change.

What follows is just a smattering of the workshops you may choose to attend. There are a variety of demonstration sessions, vendor workshops offering experiences with probeware and quite a few addressing that perennial black cloud...TAKS. I have also included a few on the list whose audience is elementary or middle school teachers since many districts are working much harder on vertical teaming, especially in science.

## Thursday

### Short Courses:

- Alternative Energy
- Black Gold, Texas Tea: How to Drill and Oil Well
- Integrated Science and Technology Labs and Ideas (\$25)

### Workshops:

- Sheltering Science for Secondary English Language Learners
- Science: It Really Matters!
- The Magic of Elementary Chemistry
- Kitchen Chemistry and the TEKS in the Secondary Classroom
- Bananas, Nuts, and Nuclear Radiation
- 10 Years of Refining Chemistry Teaching
- From Dominos to Donuts: A Tactile Kinesthetic Approach to Teaching Dimensional Analysis
- Chemistry and Physical Science with M & M's: Minerals, Meteorology, Mars, and More!
- Reading and Writing Strategies to Help the Struggling Student in the Science Classroom
- How Does Nanotechnology Impact My Students and Me?

## Friday

### Short Courses:

- Bunsen Burner Cookbook and the Original Up, Up, and Away (\$15)
- Investigation of Boyle's Law and Reaction Rates Using CBL and Pressure Probes
- Extraction of Capsaicin from Chili Peppers
- Understanding the Nature of Science for TAKS (\$10)
- No Mass Left Behind, or, Balance Your Equation and Eat It, Too (\$25)

### Workshops:

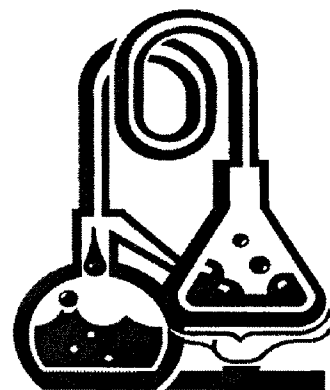
- The Paint Chip Periodic Table
- Chemistry Roadshow
- An Integrated Approach to High School Biology and Chemistry
- Way Cool Chemistry Demonstrations for Middle School
- Acquiring the Foundation: The Periodic Table of Elements for Middle School
- Fantastic Physical Science Demonstrations from Flinn Scientific
- Digger Into Deeper Understanding in Chemistry



## Friday

### Workshops, con't:

- Hands-On Data Collection Your Way, with Vernier LabPro and Computers
- Data Logging Made Easy with the Multilog Pro and Activities Aligned to the TEKS/TAKS
- Strategies for Success in Secondary Science
- Trade Show Science
- Matter Up!
- Help! My Kids Just Don't Get It! (Preventing Death by Lecture)
- Dana Center Series: Resources for Understanding the 6-12 TEKS and Grades 8, 10, and Exit Level TAKS
- Wireless Sensing Using the Imagiprobe Airlink Sensor Interface in Chemistry
- The Science of Alcohol
- CSI: Who Killed Henry Ward?
- Demonstrations in Chemistry and Physics for Elementary Teachers
- Forensics in the Classroom
- Data Collection with the CBL2: No Prior Experience Necessary
- Polygons, Patterns, and Periods: Get Your Students Ready for the Periodic Table
- Balancing Act
- The Rise and Fall of the Ionic Compound
- Ideas to Incorporate the Multidisciplinary New World of Nanotechnology in Your Classroom
- Laying the Foundation in Pre-AP Chemistry
- Hands-On Data Collection Your Way, with Vernier LabPro and Handheld Calculators



## Saturday

### Short Courses:

- Minerals Matter! Using Minerals to Teach Physical and Chemical Properties of Matter (\$10)
- Chemistry with Computers - Vernier LabPro Interface and LabPro Software
- Digging into Deeper Understanding in Chemistry

### Workshops:

- A Comprehensive 3-D Chemistry Final Project
- Using Graphing Calculators to Differentiate for Advanced Students
- Writing TAKS-style Questions for Classroom Assessments
- Tackling the TAKS: A Department-Wide Effort
- Virtual Labs for Biology and Chemistry Curricula
- Advance Your Chemistry with Food
- Hands-On Science: PASCO Probeware and the new Xplorer GLX
- Achieving Student Success Using Chemistry in the Community
- Unfold Science with Foldables
- Laying the Foundation Science Guides: Assessment for PreAP Assessments
- Dana Center Series: Understanding High School Science

## ACT<sub>2</sub> Biennial



The opening night mixer found groups exploring the periodic tables, inside and out, of the new UNT Chemistry Building. Here folks are admiring Americium, which we hope to make the ACT<sub>2</sub> element for ChemEd 07!

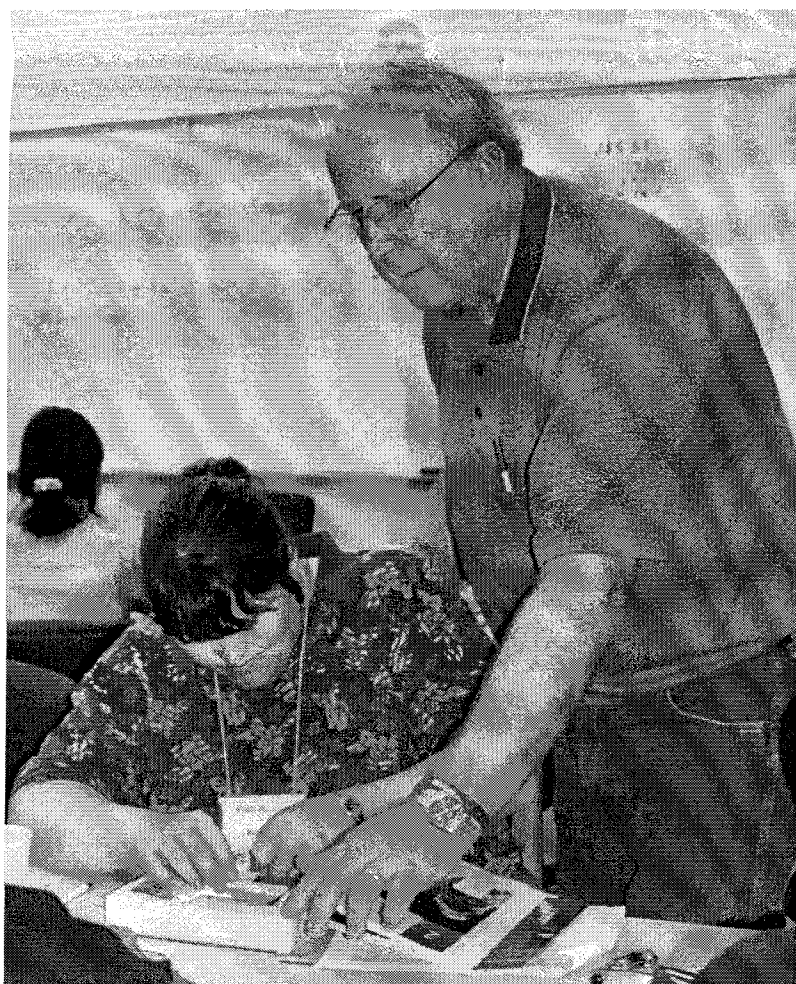


Michelle Barnet gets Lavalicious! Buy a Lava Lamp, get a tax credit and teach some chemistry - see page 13.

## The Silver Edition



Thursday night was game night: puzzles, races, and some vicious pictionary.



Cutting and punching and gluing and riveting - a good time was had by all as Dr. Larry Peck supervised the construction of the extraordinary Burning Books!

## Reap the Biennial Benefits

HERE ARE JUST A FEW OF THE MANY IDEAS OUR INVITED GUESTS SHARED IN DENTON THIS SUMMER.

Dr. John Gelder from Oklahoma State took us to his website which features some terrific MoLe's (that's molecular level laboratory experiments) which are web-simulations for topic in kinetics, gas laws, equilibrium, etc. The guided inquiry activities allow the students to explore the concept interactively and at a molecular level. The instructor's site is <http://genchem1.chem.okstate.edu/CCLI/WebSim.php>

Pat Funk encouraged us to get down and Funky and many participants walked away with beautiful tie-dyed lab coats. He also shared some great tips for showing the effects of polarization and refraction (details to follow in a mini-reACT<sub>ant</sub> issue).

Here's an old favorite he re-visited: have your students determine the percentage of sugar in bubble gum. In lab groups of 5, have the students place 5 wrapped pieces of bubble gum in a cup and determine the mass. Then each student should chew a piece of gum for 5 minutes. After 5 minutes of chewing, re-wrap the piece of gum in the wrapper and determine the mass of the 5 chewed pieces. From their data, students can calculate the mass of dissolved sugar, its percentage, and using the molar mass of sucrose - both moles and number of sucrose molecules can be calculated.

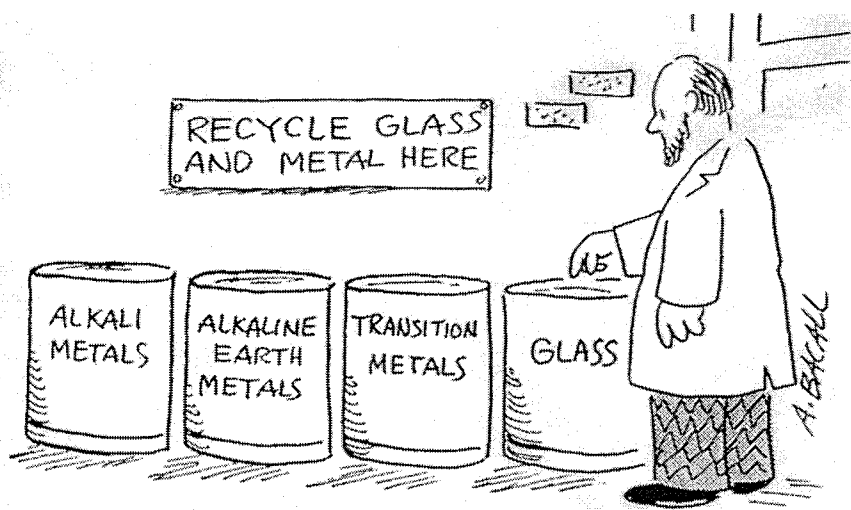
*Here's a Mole Day Bonus idea: how many pieces of gum would you have to chew to dissolve a mole of sugar (sucrose) molecules? Might be a nice lab to do on a pep rally or other altered schedule day.*

Bette Bridges from Bridgewater, Maine shared this hilarious website <http://www.peepresearch.org> that features all sorts of demented things being done to Peeps - all in the name of science!

She suggested that you can obtain large syringes (for illustrating gas laws and decreased vapor pressure to boil water) at a veterinarian supply store.

**Oily Ice** - Add *Mazola corn oil* to a 250mL graduated cylinder. Drop in an ice cube (must be home-made - freeze colored water in a film canister) and watch the density change as the ice melts. When the ice is gone, pour the oil back into the bottle, dump the water down the drain and you're ready for next year!

**Glowing Credit** - shine UV light over a credit card and look for embedded words. The new paper currency also have an imbedded UV strip - what a way to light up part of the electromagnetic spectrum!



From the cartoon collection of Andy Cherkas

the reACT<sub>ant</sub>, Fall 2005

The traditional lava lamp is composed of a glass container with three substances, each a different phase. Beneath the glass container is a 40W light bulb. When the lamp is cool, the three distinct layers can be found: a solid layer at the bottom, a clear liquid, and at the top, an air gap. The solid material is a mixture of paraffin and mineral oil, both nonpolar molecular substances. The clear liquid is actually dyed water. The air gap at the top functions to allow the expansion of the solid and liquids as they are heated.

When the light is turned on, the heat of the bulb warms the bottom of the glass container, and the paraffin/mineral oil layer begins to melt at a temperature of about 40-50 C.<sup>2</sup> As the wax melts, it increases in volume, and since its mass doesn't change, the overall density is less—and as the density decreases below 1.0 g/cm<sup>3</sup>, (the density of the water)—it begins to float within the water layer and rise to the top of the container. The lamp shape is designed to be elongated so that as the liquid wax reaches the cooler top of the container, it begins to return to a more solid phase—and it begins to contract and increase in density. It then starts to fall—where it eventually reaches the bottom of the container, coalescing with the rest of the wax. Because water and wax are not miscible, they won't mix, that is—and the “lava” will remain in blob-like pieces watch as the liquid expands as the lamp is warmed.<sup>1</sup>

- Don't tell students how the lamp works. Plug it in and as the period progresses, allow them to watch it. This is a great way to **formulate hypotheses** (TAKS 1.2A).
- If you marked the level of the liquid height with a marker before you turned on the lamp, you can now point this out to your students. Ask them to draw an **inference** (TAKS 1.2C) about what has happened and why. As they watch the change in the wax, ask them to describe what might be happening to the molecules of wax as they are heated (Chem TEK 4B). Point out that the wax seems to start out moving slowly as it melts, then seems to become “runnier” as it heats up. This is an example of one of the factors that affect **viscosity** of a fluid (TAKS 4.7A). As temperature increases, so does viscosity. You can now give students more information about the lava lamp's construction. Ask them what they think the liquid and the solid are made of.
- Bring your students' attention to the fact that the wax seems to “lift” upward, or become more **buoyant** (TAKS 4.7A). Remind students what buoyancy is, and how it is related to density of substances. In this case, as the **density** (TAKS 4.7A) of the wax decreases, it is less dense than the water and it floats. As students what the *minimum* density the wax must have to float in the water.
- The lava lamp is a good analogy for **convection** (TAKS 5.6B). As the warmer wax and water move to the top of the glass container, they cool and begin to fall again. Point out that fluids can transfer heat in this way, and this is similar to how heat is transmitted within the earth's mantle. Plates move on the earth's surface due to the plumes of molten rock (lava) that can spread them apart, shove them together, or cause one plate to move beneath another. The theory of plate tectonics is a **model** in science, and enables us to explain natural phenomenon. How well does this model explain the behavior in the earth's crust we see? (TAKS 1.3A).
- What energy transformations are taking place here? The heat from the bulb came from the **radiation** (5.6B) of the lamp, and that energy was light energy. You can feel heat coming through the glass sides if you put your hands onto the container. This is an example of **conduction**, the third type of heat transfer, (TAKS 5.6B)

## Good References:

- <sup>1</sup>ChemMatters Magazine, April 1997, “Lava Lite Lamps: A Chemical Juggling Act” by Mike McClure.
- <http://topex.ucsd.edu/es10/lectures/lecture14/lecture14.html> “Driving Forces of Plate Tectonics” by David Sandwell, (describes the lava lamp as an example of convection in the earth's crust).
- <sup>2</sup>“Use of the Lava Lamp as an Analogy in the Geoscience Classroom”, *Journal of Geoscience Education*, v. 51, n. 2, March 2003, p. 217-220.

# How Sweet It Is!



Halloween conjures up images of ghosts and goblins and things that go bump in the night; how about stomachaches and tooth decay and dentist bills galore? When I was a kid (back in the day...) Halloween was one of the few times during the year that my post-Depression era Mother would allow me to eat candy. Unfortunately I usually went a bit overboard, but hey, at least I still got to go trick-or-treating - unlike so many children today. So what's so sweet about Halloween? Why sweeteners, of course!

We can't deny what nature has made for us - built in receptors on our tongues to detect what is salty, sour, bitter and sweet. That's right - we're just doing what comes naturally when we pop a couple of sour nite-crawlers or a handful of trail mix with peanuts and M & M's. The first sweeteners on a large scale came from sugarcane from which can be extracted sugar, brown sugar, and molasses. But cutting down sugar cane is hard work, and when the British blockaded Napoleon's Navy and cut off colonial supplies - Napoleon demanded another sweet source be found - the answer came in the form of sugar beets, which were much more suited to the European climes as well as the labor pool.

In Western societies, each person consumes about 100 grams (that's 1/4 of a pound!) of refined sugar a day. We are surrounded by sugars - far more than what rests in that bowl by the cereal box.: there is sugar in fruits (fructose) and milk (lactose) and our body's primary raw material (glucose). In this day of "wasting away", we may be calorie conscious, but our bodies outsmart us when we overdo. If we end up with more glucose in our blood than we need, our bodies cleverly turn it into glycogen, an energy storage material. The aver-

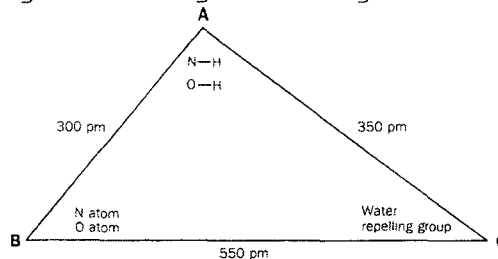
age person has about 350 grams of glycogen stored which can provide him with 1400 Calories should the need arise. Of course if we really overdo it all the time, the glucose is converted to fat rather than glycogen. drats

So with all of the "natural" sweeteners around, why search for sugar substitutes? One reason might be the sweetness factor of bulk sweeteners. Scientists rate how sweet a material is by making a 10% solution of it in water and seeing if a panel can detect the sweetness. Then the solution is diluted over and over again until finally the threshold of sweetness is crossed. While fructose has a sweetness factor of 120% compared to sucrose, lactose is only 40% as sweet. Artificial sweeteners require much smaller quantities to achieve the same sweetness. Aspartame's (NutraSweet) sweetness factor is 200%, saccharin's is 300% and sucralose's (Splenda) 600%. Artificial sweeteners are nothing new. The Romans never had enough honey to meet their sweet needs and they discovered that boiling down grape juice, or souring wine in a lead pot, produced sapa which enhanced the flavors of their wines. Unfortunately the lead acetate that made the sapa taste sweet wasn't so healthy for the Romans or their Empire.

Scientists are still working on exactly why some substances taste sweet to us, but the clue seems to lie in the molecular structure. To trigger the sweetness receptors on the tongue, a molecule must have three groups at very specific distances. (Note the triangle of sweetness below).

So - how sweet is it? Well, it all depends upon the structure and as any good biologist will tell you, structure determines function.

I say - where's my Bit-o'-Honey?



A great book to read if you can find it (and the reference I used for this article) is John Emsley's The Consumer's Good Chemical Guide 1994.

He also wrote an article on sweeteners for ChemMatters.





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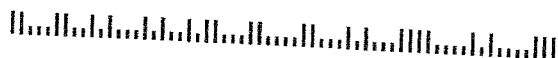




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